Mass Casualty Triage Simulation for Emergency Preparedness & Response

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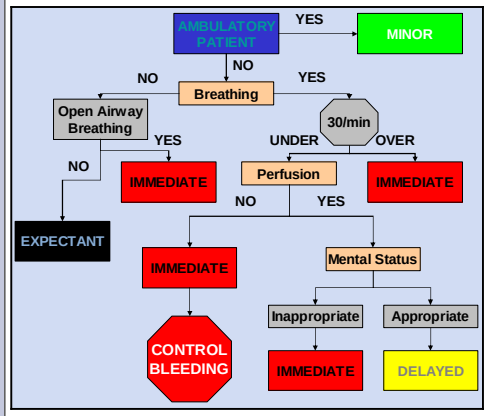
Introduction

Medical simulation can be used to enhance the educational experience and effectively train health care personnel to triage victims in the setting of a Multiple Casualty Incident (MCI), providing valuable experience and an appreciation of coordinated disaster response, ultimately improving the competence of skills across various occupations and scopes of practice.

Triage is the process of establishing the priority of care among casualties when the number of ill or injured needing care exceeds available resources. The guiding theory of effective triage is to accomplish the best for the most using the least.

Various triage methods have been developed since its original inception during the Crimean wars. Within the United States civilian sector, the Simple Triage and Rapid Transport (START) triage system, developed by the Hoag Hospital and Newport Beach (CA) Fire Department, is most widely used and considered the field-standard for triage among Disaster Medical Assistance Teams and local emergency services agencies today.

The START system relies upon making a rapid assessment of every victim, determining which of four categories these patients should be assigned and visibly identifying the appropriate category for rescuers who will treat the patients. These triage priorities are an expression of the clinical precedence of care. In ascending order of severity, designations are Minor, Delayed, Immediate, Expectant and Deceased.



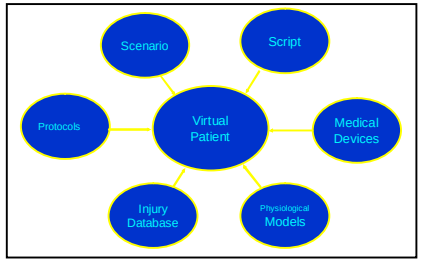
The START method employs a deterministic algorithm based upon three physiologic characteristics:

- Respiratory status: If present, >30 or <12 per minute
- Quality of perfusion: Presence or absence of peripheral pulses
- Mental status: Demonstrated ability to obey simple commands

The flowchart above depicts the clinical decision tree providers must rely upon to enact effective triage during an MCI.

Methods & Development

The Sim-Patient Triage Simulator presents users with graphically intense casualties that demonstrate signs and symptoms related to mechanism of injury and physiologic status. Scenarios are comprised of an interactive 3D scene, an incident that produces traumatic conditions and one or more patients. The caregiver can navigate and survey the scene, as well as interact and converse with the virtual patient. Using medical tools, administering medications, monitoring diagnostic data and performing treatment interventions, users may exercise their patient management skills. Health care providers can sharpen their assessment and decision-making skills to develop an appreciation for patient responses to appropriate and inappropriate patient management.

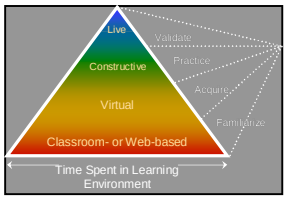


The characters demonstrate dynamic facial expressions, gestures, body movements and can portray anger, fright, confusion or other behaviors based upon cognitive, emotional, physiological and pathological models.
Additional attributes which provide effective portrayal of disaster casualties include:

- Dynamic skin texturing of clinical signs and injuries
- Full body medically-relevant animations
- Multi-layered, deformable and removable clothing
- Breathing chest motion integrated with real-time physiology
- Interactive body regions for patient assessment
- Appropriate physiologic response to medical interventions
- Real-time pharmacokinetic modeling of medication administration

Learning Management System

Multicasualty triage is a perishable cognitive skill which is not a regular part of any health care provider's job and frequently opposes core concepts of single or low-volume patient care and management. Current triage training relies upon didactic sessions and tabletop training prior to live actor exercises which require significant advanced planning and coordination.



The Sim-Patient Triage Simulator Learning Management System (LMS) integrates didactic learning content, knowledge assessment and case-based scenarios in a SCORM compatible framework. The LMS follows the Familiarize, Acquire, Practice and Validate (FAPV) method for self-paced learning by doing. The LMS tracks student activity and fulfillment of learning requirements for continuing education recordkeeping. A hierarchical content structure, organized as course-module-segments, presents learning material in various media formats. Assessment questions and interactive 3D simulation scenarios are linked to training information.

The Sim-Patient Triage Simulator LMS guides the user through occupation-specific standardized assessment and treatment protocols, challenging the user with increasingly complex scenarios. All user interactions are recorded for after-action review, along with an array of the synthetic character's pertinent physiological and behavior data.

The Sim-Patient Triage Simulator was developed to provide training for military health care providers using dynamic, multiple-casualty scenarios to reinforce triage methods and skills associated with providing initial field care to inured warfighters.

Case ID	Primary injury	Complications	Treatment Notes
1	Head, blunt trauma	Closed head injury	Evacuate
2	Head, penetration	Minor bleeding	First aid
3	Burn	Airway obstruction, fluid loss	airway and fluid management
4	Chest penetration	Pneumothorax, hemothorax	Thoracentesis, chest tube
5	Blunt trauma/abdomen	Internal bleeding	Evacuate
6	Severe Orthopedic: pelvic and long bone	Internal bleeding, extremity function	Splint, evacuate
7	Thigh penetration: exit wound	Arterial bleeding, possible fracture	Pressure dressing,splint
8	Amputation	Arterial bleeding	Tourniquet
9	Panic	Anxiety reaction, hyperventilation	Calming, Re, O_2

Casualty design is consistent with Advanced Trauma Life Support (ATLS) module injuries to provide users with an opportunity to exercise their assessment and management skills upon an array of conditions. A standard system currently supports up to nine casualties in a single scene. Each character has its own injury model, dynamic underlying physiologic state and external signs and symptoms which reflect the patient's evolving condition.

Future Directions

In June 2006, we will evaluate the influence of this technology upon conventional triage education in a randomized controlled trial of medical students at Duke University. Performance metrics will be obtained using masked data collection of trainee enacted triage upon standardized patients and the START algorithm, normalized on a scale from 0-100%, will be used to compare student performance.